The sub-system for project methodology choosing in the information technology*

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Abstract

Project management methodologies are widely used to structure development processes and increase the likelihood of project success. However, the incorrect selection of methodology remains an underestimated factor contributing to project failure. This study explores the correlation between project outcomes and methodology choice through a filled in targeted questionnaire distributed to project management professionals. The results reveal weak but notable correlations and suggest that adapting methodology during a project can significantly increase success rates. Based on the collected data, a mathematical design for an intelligent information sub-system is proposed with usage of Laplace smoothing and synthetic example, aimed at supporting project managers in selecting the most suitable methodology for future projects. The sub-system relies on empirical data and simple predictive calculations to provide evidence-based recommendations tailored to specific project parameters.

Keywords

Project Management; sub-system; information system; project management methodology; agile; questionnaire; Laplace smoothing

1. Introduction

In the contemporary landscape of information technology, virtually all development activities are conducted within the framework of structured project management methodologies. These methodologies serve a critical role in bringing order, predictability, and strategic planning to complex development processes, thereby increasing the likelihood of achieving project objectives within predefined constraints such as time, budget, and quality. The use of project management principles is not confined solely to the IT sector; it has also been widely adopted across various industries and domains, including construction, healthcare, education, and public administration. In all these fields, project management is employed with the common goal of enhancing the efficiency, transparency, and success rate of projects.

As projects continue to grow in scale, complexity, and interdependency, the corresponding evolution of project management practices has become both necessary and inevitable. Traditional methodologies such as Waterfall and PRINCE2, while still relevant in specific contexts, are increasingly being complemented or replaced by more flexible, iterative frameworks. In particular, the emergence of methodologies under the Agile umbrella, such as Scrum, Kanban and Hybrid, has significantly transformed the way organizations approach project planning and execution. These methodologies emphasize adaptability, continuous feedback, and close collaboration between stakeholders, and have been widely embraced by both small enterprises and multinational corporations.

Simultaneously, a broad range of software tools and platforms have been developed to support the planning, monitoring, and control of project activities. Despite these advancements in both theory and practice, project failure remains a persistent issue across industries. Projects may fail due to various reasons, including unclear objectives, inadequate resource allocation, stakeholder misalignment, or insufficient risk management. One particularly critical, yet often underestimated,

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factor contributing to project failure is the inappropriate selection or application of a project management methodology. Choosing a methodology that does not align with the specific characteristics of a given project can significantly undermine its chances of success.

At present, there is a notable absence of intelligent, adaptive information systems designed to assist project managers in selecting the most suitable project management methodology for their specific context. Such a system could potentially analyze past project data, identify patterns and correlations, and provide evidence-based recommendations tailored to the unique parameters of a new project. The aim of this work is to present the conceptual foundation and key components of such a system, exploring how it can contribute to more informed decision-making and, ultimately, to improved project outcomes.

2. Proposed technique

The phenomenon of project failure has been the subject of extensive academic investigation across multiple disciplines, particularly within the fields of management science and information technology. Prior studies, such as those conducted by various scientist [4], [8], and [12], have approached the topic using a broad analytical framework. These works primarily concentrated on high-level elements such as project planning inefficiencies and risk management deficiencies [10,11]. While these aspects are undeniably critical to understanding project outcomes, they often fail to examine in depth the specific influence of project management methodology selection on project success or failure [7].

One particularly under explored area in this context is the correlation between the application of an inappropriate project management methodology and project failure. Although the issue has been acknowledged in passing within the scientific research [17], there has been a lack of systematic, empirical research explicitly designed to isolate and quantify this relationship [6]. Identifying such a correlation requires a more targeted investigative approach [9]. A structured questionnaire directed toward project management professionals and practitioners was therefore developed to address this research gap.

While a number of existing surveys have attempted to explore project-related challenges [2], they generally encompass a broad spectrum of variables and do not isolate methodology-specific factors. In contrast, the survey employed in this study was explicitly oriented toward project management methodologies and their impact on project outcomes. The questionnaire was developed in alignment with commonly applied methodologies referenced in the article [5] and was previously described in earlier scientific work [3]. Its aim was to gather specific insights from individuals directly involved in managing or participating in projects, focusing particularly on methodology usage, project outcomes, and risk-related experiences. The aggregated results of this specialized online project manager focused survey are summarized in Table 1, which provides an overview of key indicators derived from the collected responses.

Table 1
Results of questionnaire outcome

Formula name	Results
Project failure rate	42,35%
Project success rate	57,65%
Stakeholder involvement	38,82% - weekly
Resource availability	74,12%

Initial methodology	Scrum – 60%; Kanban – 4,71%; Waterfall – 4,71%; Hybrid – 18,82%; No methodology – 4,71%; Other – 7,06%
Wrong methodology	29,41%
Not remediated risk	Scope creep – 67,5%; Budget overrun – 23,75%; Team retention – 12,5%; Unclear requirements – 10%
Remediated risk	Scope creep – 69,23%; Budget overrun – 24,36%; Team retention – 12,82%; Unclear requirements – 10,26%
Correlation between project failure and wrong methodology	0.058 Weak correlation
Correlation between risk monitoring frequency and project failure	0,098 Weak correlation
Correlation between team composition and project failure	0,069 Weak correlation
Correlation between project complexity and project failure	-0,02 No correlation
Correlation between project failure and project industry	Tech -12,5%; Healthcare – 57,14%; Retail – 0%; Finance – 30%; Transportation – 0%; Food and beverages – N/A; Logistics – 25%; E-Commerce – 33,33%; Edtech – 100%; Government – N/A%; Oil&Gas – 66,67%; Manufacturing – 0%; Other – 60%

Despite the overall weak correlation between project failure and incorrect methodology choice, an auxiliary calculation revealed a substantial insight: projects that underwent a successful change in methodology experienced a 30.1% increase in the probability of success. This finding, while preliminary, underscores the potential value of dynamic methodology reassessment throughout the project life cycle.

In addition to offering insight into present trends, the collected data will also serve as a foundational reference for the continuation of development of an intelligent information system designed to assist project managers in selecting the most appropriate methodology for their projects [1]. This system will rely on historical data to offer predictive recommendations tailored to specific project parameters. The conceptual architecture and key sub-systems of this system are depicted in Figure 1, illustrating the functional relationships among its modules.

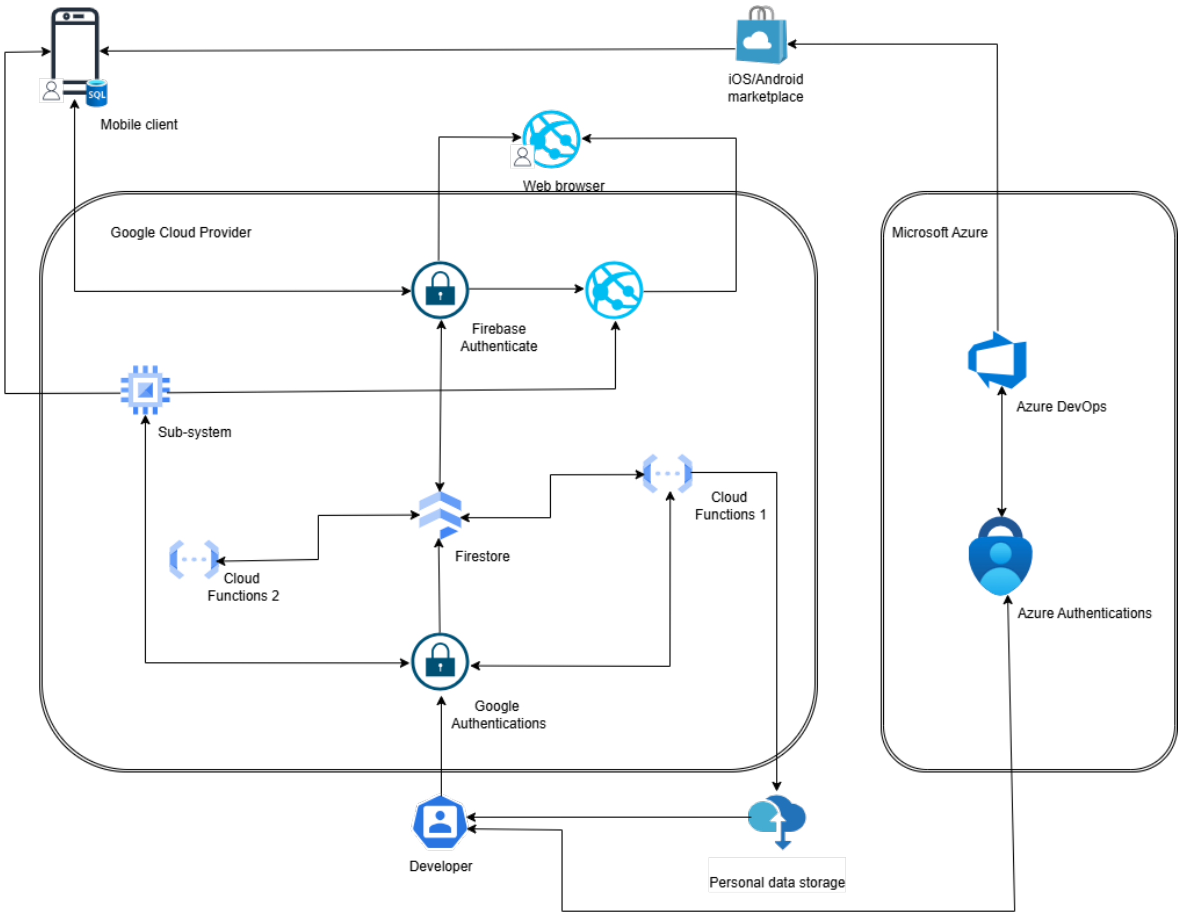

Figure 1: High level architecture of information system for project methodology choosing

Sub-system that is responsible for calculating suggestion for project success based on short list of questions that will be asked through the interface of information system. Those questions are listed in Table 2 below. And suggestions are based on most common project management methodologies such as Scrum, Kanban, Waterfall and Hybrid [13,14].

Table 2
List of questions for sub-system calculations with normalized values

Question	Answer	Answer options	Numeric Value
Project duration	Select	Less than Year; Year; 2+ Years	1; 2; 3
Project size	Select	Small (up to 10 people); Medium (11-50); Large (50+)	1; 2; 3
Project nature	Select	KTLO/Support; Integration; Development; Infrastructure; Other	1; 2; 3; 4; 5
Project industry	Select	Tech; Healthcare; Retail; Finance; Transportation; Food and beverages;	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13

	Logistics; E-Commerce; Edtech; Government; Oil&Gas; Manufacturing; Other

After receiving the data from mentioned shortlisted questionnaire sub-system will start to perform calculations according to this formula:

$$P_{¿} = max \sum_{i=1}^{5} M_i \cdot P_d \cdot P_s \cdot P_n \cdot P_{ind} \tag{1}$$

where $P_{¿}$ is probability based on inputs [15], M_i is success-based rate of methodology, P_d is project duration likelihood based on input value, P_s is project size likelihood based on input value, P_n is project nature likelihood based on input value, P_{ind} is project industry likelihood based on input value.

Success based rate of methodology can be calculated with help of next formula:

$$M_i = \frac{P_{success}}{P_{all} \cdot (1 - CR)} \tag{2}$$

where $P_{success}$ is quantity of success projects with i-methodology, P_{all} is all projects with i-methodology and CR is change rate, value of projects that changed method from i-methodology. It calculates with this formula:

$$CR = \frac{P_{change}}{P_{success}} \tag{3}$$

where P_{change} is quantity of projects with i-methodology changed.

Likelihood based variables different set of formulas will be used. But since in the data there some gaps in some answers, like absence of some of industries Laplace smoothing will be used to avoid zero probabilities in calculations. For likelihood of project duration formula will be next:

$$P_{d_j} = \frac{P_{success_j} + \alpha}{\sum_{i=1}^{5} P_{success_i} + j \cdot \alpha} \tag{4}$$

where P_{d_j} is j value for project duration according to values in data (in other words likelihood for 1 year project duration, less than year, 2+ years), $P_{success_j}$ is quantity of successful projects with given j value and α is Laplace smoothing, in current case it's equals 1. J in case of duration equals 3.

$$P_{s_j} = \frac{P_{success_j} + \alpha}{\sum_{i=1}^{5} P_{success_i} + j \cdot \alpha} \tag{5}$$

where P_{s_j} is j value for project size according to values in data (small, medium, large). In this case j equals 3.

$$P_{n_j} = \frac{P_{success_j} + \alpha}{\sum_{i=1}^{5} P_{success_i} + j \cdot \alpha} \quad (6)$$

where P_{n_j} is j value for project nature according to values in data (small, medium, large). In this case j equals 5.

$$P_{ind_j} = \frac{P_{success_j} + \alpha}{\sum_{i=1}^{5} P_{success_i} + j \cdot \alpha} \quad (6)$$

where P_{ind_j} is j value for project industry according to values in data (small, medium, large). In this case j equals 13.

Next series of calculations should be calculation of M_i and CR that will be shown in Table 3

Table 3

M_i calculation results

Methodology	Total projects	Successful projects	M_i	Changed projects	CR
Scrum	51	29	0.47	10	0.35
Kanban	4	3	0.5	2	0.67
Waterfall	4	3	0.5	1	0.33
Hybrid	14	8	0.5	1	0.13
Other	8	4	0.5	0	0

Other in methodology have a minority in current data set but they still need to be presented for calculation purposes.

To have more practical approach example calculation should be used. For those calculation purposed next parameters will be used: duration is “Less than Year”; team size is “Small”; project nature is “KTLO/Support” and project industry is Oil&Gas.

Table 4

Quantity of project success based on project size

Size	Scrum	Kanban	Waterfall	Hybrid	No methodology
Small (up to 10 people)	6	1	2	4	1
Medium (11-50 people)	16	2	0	3	1
Large (50+ people)	7	0	1	2	2

Results shown in this table are static and provide logic of overall calculations, because this step of stating quantity of the project successes should be repeated for other parameters such as Nature, Duration and Industry.

Table 5
Likelihood for Project Size

Size	Scrum	Kanban	Waterfall	Hybrid	No methodology
Small (up to 10 people)	0.41	0.12	0.18	0.31	0.12
Medium (11-50 people)	0.71	0.13	0.04	0.17	0.08
Large (50+ people)	0.62	0.08	0.15	0.23	0.2

Results for this table are our foundation for calculation because those values will not be changed and will stay static till new data from questionnaire arrived. But if current data should be interpreted it show that likelihood for Scrum is noticeable bigger that other likelihoods and in this case it means that Scum have higher chances to be successful as project methodology.

Result Table 6 for P_{s_j}'s will have next view

Table 6
P_{s_j} calculation results

P_{s_j} Methodology	Value
Scrum	0.26
Kanban	0.03
Waterfall	0.02
Hybrid	0.08
Other	0.04

Same calculations should be repeated to calculate P_{d_j}, P_{n_j} and P_{ind_j}. They will not be presented in this article due to it repetitive nature and partial confidentiality of the data. After calculations $P_{¿}$ can be calculated. For instance if input values are (Less than Year; Small; KTLO/Support; Oil&Gas) max value of $P_{¿}$ will be for Scrum with 0.002324 value.

3. Conclusion

This study demonstrates the potential of using systematically gathered empirical data to inform the selection of project management methodologies for future projects. By analyzing correlations between specific project characteristics, risk factors, and outcomes from past initiatives, it becomes possible to calculate the likelihood of success associated with particular methodologies in new project contexts. The proposed approach lays the groundwork for a methodology-assistive information system capable of supporting project managers in making evidence-based decisions at the planning stage.

Such a system would be particularly valuable in environments where project conditions are ambiguous or where the project manager lacks historical organizational data to guide their choices. By providing data-driven recommendations, the system can act as a decision-support tool that complements professional judgment rather than replacing it.

Also, the ability to quantitatively estimate the suitability of different methodologies based on minimal input about an upcoming project introduces a layer of predictive analytics into the traditionally experience-driven field of project management. As a result, organizations may benefit from enhanced planning efficiency, more strategic risk mitigation, and improved alignment between project approach and project complexity, size, or industry.

Future work may focus on refining the predictive model by applying machine learning techniques to continuously improve the accuracy of recommendations. The developed sub-system of information system could also be integrated with project management platforms, making it a seamless component of project initiation workflows

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Declaration on Generative AI

During the preparation of this work, the authors used ChatGPT in order to: Paraphrase and reword. After using this tool/service, the authors reviewed and edited the content as needed and takes full responsibility for the publication’s content.

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